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GROUND COVER ALTERNATIVES AT FIRE-WEATHER STATIONS

William C. Fischer[1]

ABSTRACT

Results indicate that either a bed of gravel or of coniferous needles would provide an acceptable substitute in areas where natural vegetation is lacking and cannot be maintained without irrigation.

Instrument shelters at fire-weather stations should be situated over a low, well-clipped cover of natural vegetation because the instrument shelters are used to obtain temperature readings that are representative of the surrounding outside air. To minimize radiant heat effects on the instruments inside, the shelter should be painted white, inside and out, and provided with a double roof. Sides should be louvered to allow free movement of air past the instruments without allowing entry of radiant heat. Openings in the shelter floor also contribute to air movement inside the shelter.

The type of ground surface under the instrument shelter is important for much the same reasons. A smooth, light-colored surface, such as concrete, can reflect the sun's rays directly into the shelter through openings in the sides and floor. A dark surface, such as blacktop, quickly absorbs great amounts of the sun's heat. This causes the air above such a surface to become warmer than the surrounding air. Unless carried off by wind, this warm air can rise and enter the shelter through side and floor openings. A natural vegetation ground cover usually minimizes excessive heating by convection and by reflection.

WHAT IF VEGETATION WON'T GROW?

If your fire-weather station needs to be located in an area where vegetation won't grow--on bare, rocky mountaintops or in excessively dry valley bottoms--ground surfaces of gravel and forest litter have been suggested as alternatives to natural vegetation in such situations. A third alternative, bare ground, is not generally considered acceptable because it can become dusty during dry periods and muddy during wet periods.

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[1]Research Forester, stationed at the Northern Forest Fire Laboratory, Missoula, Montana.

FOUR GROUND COVERS STUDIED

A study was conducted at the Ant Flat Work Center in northwestern Montana's Kootenai National Forest to find out what differences in instrument shelter temperature would occur over different ground surfaces. A grassy flat was divided into four adjoining plots measuring 25 feet on each side. At the center of each plot, a standard Weather Service type instrument shelter was installed. A different ground surface was established under each shelter (fig. 1): (1) a low-clipped natural vegetation; (2) a 2-inch-deep duff bed of coniferous needles; (3) a 2-inch-deep bed of washed medium-sized gravel; and (4) a low-clipped watered lawn. Each shelter was equipped with a set of standard maximum-minimum thermometers and an electric fan psychrometer.

On the watered lawn plot, a small rotary sprinkler was operated every other morning from 8 to 9 a.m. Water was not applied if 0.10 inch or more precipitation occurred during the previous 24-hour period. The watered lawn plot was located downwind to prevent the other plots from being affected by moisture.

Daily observations of dry bulb, wet bulb, maximum, minimum, and current temperatures[2] were taken from each of the four instrument shelters during July, August, and September of 1967 and 1968. To minimize differences resulting from various observation times, readings were taken between 5 and 6 p.m., when temperatures usually held steady in the study area. All readings were completed in 10 minutes. Instruments were rotated between shelters each week to minimize instrument bias.

The 65 sets of observations obtained in this experiment were analyzed for statistically significant differences. Using the *t* test for paired plots, daily readings taken over each of the three alternative surfaces were compared in turn to the readings

Figure 1.--Three of the four study plots are seen here; the conifer needle litter plot is out of sight. The observer is at the natural vegetation plot, the gravel plot in the lower right, and the watered lawn in the upper right.

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[2]Current temperature read from minimum thermometer.

taken over the natural vegetation surface. The windspeed at observation time, which averaged 3.2 mi/h for all observations, was not considered during initial data analysis. However, the effect of windspeed was taken into consideration for subsequent analysis.

HOW THEY COMPARED

Initial analysis found statistically significant differences (95 percent confidence level) between current and maximum temperatures taken over the watered lawn and similar measurements taken over the standard natural vegetation surface (table 1). The figures in table 1 are averages; therefore, they do not reflect the range of variation that occurred between individual readings for the same day. However, they do indicate the conditions sampled and the direction of the differences. It is reasonable to assume that differences shown for the watered lawn plot would have been larger had a more liberal irrigation schedule (one more closely approximating actual practice) been followed.

Subsequent analyses, which considered windspeed at observation time, verified these initial findings and pointed out several additional differences. In comparing observations recorded for the watered lawn with those for the natural vegetation, statistically significant differences appeared between current temperature readings whenever windspeeds averaged less than 5 mi/h. On the other hand, minimum temperature differed significantly when windspeed was less than 2 mi/h or more than 5 mi/h, but not when windspeed ranged between 3 to 5 mi/h. A significant difference in wet bulb temperature under light wind conditions (0 to 2 mi/h) was also indicated.

The only other additional statistically significant differences occurred during periods of calm or light winds (0 to 2 mi/h). These differences involved current temperature over the gravel surface and wet bulb temperature over the bed of coniferous needle litter.

APPLICATION

The general requirement that weather station instrument shelters be established over a ground surface of natural vegetation is sound. Besides being a relatively neutral reflective surface, the cover remains basically unaltered by rain and wind and is easy to maintain in a uniform low-clipped condition. Because uniformity of observation practice is a major factor in quality control, alternative ground covers should be considered only where vegetation is lacking and its establishment and maintenance impossible without artificial watering.

This study supports the general prejudice against irrigating in the vicinity of a fire-weather station. It also indicates that a coniferous needle bed or a bed of washed gravel can provide acceptable alternative ground surfaces for fire-weather station instrument shelters if a vegetative cover cannot be established and maintained without irrigation.

If a bed of gravel or litter is used under the instrument shelter, any differences in temperature readings from what might be expected over a standard natural vegetation surface are likely to occur only during periods of low windspeeds or calm. Since daily observation time usually is set to sample the most severe fire-danger conditions (i.e., when windspeed and temperature are near their daily peaks and relative humidity near its daily low), such differences should not occur often enough to be a serious problem.

DOES NOT APPLY TO FUEL STICKS

These results should only be applied to temperature and humidity measurements obtained inside a standard Weather Service type shelter installed 4 feet above the ground surface. *Do not* apply these results to the exposure of fuel moisture sticks or other analogs of fuel moisture. These devices are commonly located just above the ground surface and could be greatly affected by ground cover characteristics.

Table 1.--*Averages of all measurements taken over the four different ground surface treatments*[1].

Ground surface treatment	Average temperatures										Average relative humidity	
	Max. temp.		Min. temp.		Current temp.		Wet bulk temp.		Dry bulb temp.			
	Average	Diff.	Average	Diff.	Average	Diff.	Average	Diff.	Average	Diff.	Average	Diff.
	°F.										Percent	
Natural vegetation	81.0		39.5		76.5		56.4		76.3		34.0	
Conifer needle litter	80.9	-0.1	39.3	-0.2	76.5	0	56.3	-0.1	76.3	0	33.5	-0.5
Gravel	80.9	-.1	39.5	0	76.3	-.2	56.4	0	76.2	-.1	34.1	+.1
Watered lawn	80.7	[2]-.3	39.6	+.1	76.2	[2]-.3	56.4	0	76.1	-.2	34.5	+.5

[1] Differences in windspeed are not considered in this summary.

[2] Statistically significant difference (95 percent confidence level).

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